CLAIMS

What is claimed is:

1. A method for removing camera tilt distortion from a panoramic photograph comprising the steps of:
   a) obtaining a first digital representation of the photograph; and
   b) establishing a correspondence between pixel locations in a rectified second digital representation of the photograph and pixel locations in the first digital representation; and
   c) copying pixel data from pixel locations in the first digital representation to the corresponding pixel locations in the second digital representation.

2. The method of claim 1, further comprising storing the rectified second digital representation.

3. The method of claim 1, further comprising printing the rectified second digital representation.

4. The method of claim 1, wherein establishing a correspondence between pixel locations in the rectified second digital representation of the photograph and pixel locations in the first digital representation further comprises the steps of:
   a) mapping pixels in the rectified second digital representation of the photograph to camera viewing directions; and
   b) computing intersections of the viewing directions with a conceptual cylindrical image surface; and
   c) mapping the intersections to pixel locations in the first digital representation of the photograph.

5. The method of claim 4, further comprising storing the rectified second digital representation.

6. The method of claim 4, further comprising printing the rectified second digital representation.

7. The method of claim 4, further comprising the steps of:
   a) identifying a zenith pixel in the first digital representation of the photograph; and
   b) measuring pixel locations in the first digital representation of the photograph in relation to the zenith pixel.

8. The method of claim 4 wherein copying pixel data from a location in the first digital representation of the photograph is accomplished using interpolation.

9. The method of claim 4 wherein the conceptual cylindrical image surface has a radius equal to a focal length of a lens of the panoramic camera.

10. The method of claim 4 further comprising identifying an angle at which a rotational axis of the camera was tilted from vertical at the time the photograph was taken.

11. The method of claim 1, wherein establishing a correspondence between pixel locations in the rectified second digital representation of the photograph and pixel locations in the first digital representation further comprises the steps of:

a) mapping pixels in the first digital representation of the photograph to camera viewing directions; and

b) computing intersections of the viewing directions with a conceptual cylindrical image surface; and

c) mapping the intersections to pixel locations in the second rectified digital representation of the photograph.

12. A data processing system for removing camera tilt distortion from a panoramic photograph comprising:

a) processor means for processing data; and

b) storage means for storing data on a storage medium; and

c) program means for reading a first digital representation of the photograph; and

d) program means for establishing a correspondence between pixel locations in a rectified second digital representation of the photograph and pixel locations in the first digital representation; and

e) program means for copying pixel information from the locations in the first digital representation to the pixel locations in the second rectified digital representation.

13. The data processing system of claim 12 wherein the program means for establishing a correspondence between pixel locations in the rectified second digital representation of the photograph and pixel locations in the first digital representation further comprises:

a) program means for mapping pixel locations in a rectified second digital representation to camera viewing directions; and

b) program means for mapping the camera viewing directions to locations on a conceptual tilted cylindrical image surface; and

c) program means for mapping locations on the tilted cylindrical image surface to pixel locations in the first digital representation.

14. The data processing system of claim 13 further comprising program means for storing the second rectified digital representation.

15. The data processing system of claim 13 further comprising program means for printing the second rectified digital representation.

16. A camera comprising a data processing system programmed to remove camera tilt distortion from a digital representation of a panoramic photograph.

17. The camera of claim 16 further comprising:

a) program means for reading a first digital representation of the photograph; and

b) program means for mapping pixel locations in a rectified second digital representation to camera viewing directions; and

c) program means for mapping the camera viewing directions to locations on a conceptual tilted cylindrical image surface; and

d) program means for mapping locations on the tilted cylindrical image surface to pixel locations in the first digital representation; and

e) program means for copying pixel information from the locations in the first digital representation to the pixel locations in the second rectified digital representation.

18. The camera of claim 17 further comprising program means for storing the second rectified digital representation.

19. The camera of claim 17 further comprising program means for printing the second rectified digital representation.

20. A computer programmed to remove camera tilt distortion from a digital representation of a panoramic photograph comprising:

a) program means for obtaining a first digital representation of the photograph; and

b) program means for establishing a correspondence between pixel locations in a rectified second digital representation of the photograph and pixel locations in the first digital representation; and

c) program means for copying pixel data from pixel locations in the first digital representation to the corresponding pixel locations in the second digital representation.

21. The computer of claim 20 wherein the program means for mapping pixel locations in the rectified second digital representation of the photograph to corresponding pixel location in the first digital representation further comprises:

a) program means for mapping pixel locations in a rectified second digital representation to camera viewing directions; and

b) program means for mapping the camera viewing directions to locations on a conceptual tilted cylindrical image surface; and

c) program means for mapping locations on the tilted cylindrical image surface to pixel locations in the first digital representation.

22. A computer-readable storage medium containing a program for removing camera tilt distortion from a panoramic photograph, the program comprising:

a) program means for obtaining a first digital representation of the photograph; and

b) program means for mapping pixel locations in a rectified second digital representation of the photograph to corresponding pixel locations in the first digital representation; and

c) program means for copying pixel data from pixel locations in the first digital representation to the corresponding pixel locations in the second digital representation.

23. A method for correcting distortion induced by camera tilt in a panoramic photograph comprising:

a) obtaining a first digital representation of the photograph; and

b) selecting a plurality of camera viewing directions; and

c) determining locations in a rectified second digital representation of the photograph where objects in the viewing directions should appear; and

d) determining corresponding locations in a first digital representation of the photograph the objects do appear; and

e) transferring pixel data from locations in the first digital representation to the corresponding locations in the second digital representation.

24. The method of claim 23, further comprising identifying an angle by which a rotational axis of the camera deviates from vertical.

25. The method of claim 23 further comprising storing the rectified second digital representation of the photograph.

26. The method of claim 23 further comprising printing the rectified second digital representation of the photograph.

27. A method for correcting distortion induced by camera tilt in a panoramic photograph comprising:

a) obtaining a first digital representation of the photograph; and

b) selecting a plurality of camera viewing directions; and

c) determining locations in the first digital representation of the photograph where objects in the viewing directions appear; and

d) determining corresponding locations in a second rectified digital representation of the photograph where the objects should appear; and

e) transferring pixel data from locations in the first digital representation to the corresponding locations in the second digital representation.

28. The method of claim 27, further comprising identifying an angle by which a rotational axis of the camera deviates from vertical.

29. The method of claim 27 further comprising storing the rectified second digital representation of the photograph.

30. The method of claim 27 further comprising printing the rectified second digital representation of the photograph.